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Commentary

# Measurement of Pollution History

## by E. D. Goldberg*

We have developed a technique to measure the history of pollution exposure levels in the environment based upon the introduction of a time-clock to glacial, lacustrine, and marine sediments. The technique involves the use of 210 Pb, a radioactive member of the 238 U series, which decays with a half-life of 22 yr. This lead isotope enters surface waters unsupported by its parents in the U-238 series, such as radium or radon. Rapidly removed to the sediments, its decay can be measured over an interval of about 100 yr. Yearly strata can be identified. For those materials introduced to the atmosphere or to waters as pollutants and rapidly sedimented, this dating technique allows the development of the historical record of environmental levels.

We have recently reported *(1)* the use of this technique in studying the record of lead pollution in Southern California. Lead is introduced by man to the environment by the combustion of tetraethyllead and tetramethyllead in internal combustion engines, where it acts as an antiknock agent. Subsequently, it is returned from the atmosphere to land water surface in dry fallout and in precipitation. The lead levels in the coastal environment appear to have increased by a factor of ten over the past 20 yr from the development of the sedimentary record (Fig. 1).

In the same sediments we have looked at the exposure levels of carbon particles introduced to the atmosphere from the combustion of fossil fuels and of forests. We have found evidence of the combustion of fossil fuels in the sediments through enhanced carbon contents depositing over the past several decades, however, the amounts are small compared to those introduced from forest fires.

One of the inadequacies of our technique is that we are often unaware of the contributions from various sources for a given pollutant. For example, the anthropogenic lead in the sediments off Southern California could have fallen out directly from the atmosphere, been washed off land surfaces by rain into sewers and discharged into the oceans, or washed off land surfaces by storm surges to the oceans.

A second inadequacy involves the preferential accumulation of particulate pollutants in sediments where there are high concentrations of filter feeding organisms in overlying waters. The transfer from surface waters to the deposits is often enhanced by such organisms as clams, mussels, and oysters which can effectively filter out particles of sizes of microns or even less from water and discharge such particles as fecal pellets which rapidly fall to the sediments. If you are in an area where there are large numbers of these organisms, you can have a preferential accumulation of particles in the sediment. The result is that values of fluxes for the area under concern are too high.

In spite of these constraints, we have successfully applied this technique to many coastal and lacustrine areas for the measurement of exposure levels of heavy metals and elemental carbon contaminants.

*Scripps Institution of Oceanography, La Jolla, California 92037.

### REFERENCE

1. Chow, T. J., et al. Lead pollution: records in Southern California coastal sediments. Science **181**: 551 (1973).

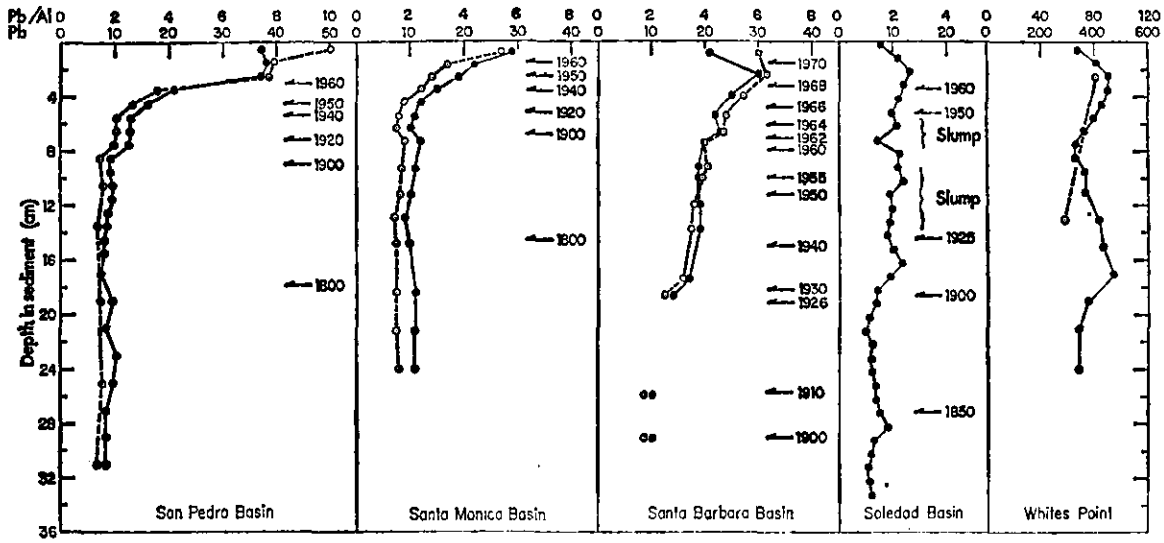


FIGURE 1. Plots of (●) lead concentrations (in parts per million) and (O) lead/aluminum ratios ($\times 10^{-4}$) in sediments from the from the Santa Monica, San Pedro, and Santa Barbara basins off Southern California, from the Soledad Basin off the coast of Baja California, and from a site near the Whites Point, Los Angeles County outfall.